

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
20 April 2006 (20.04.2006)

PCT

(10) International Publication Number
WO 2006/040278 A1

(51) International Patent Classification:
B60K 15/035 (2006.01)

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(21) International Application Number:
PCT/EP2005/055010

(22) International Filing Date: 5 October 2005 (05.10.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/617,054 12 October 2004 (12.10.2004) US

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

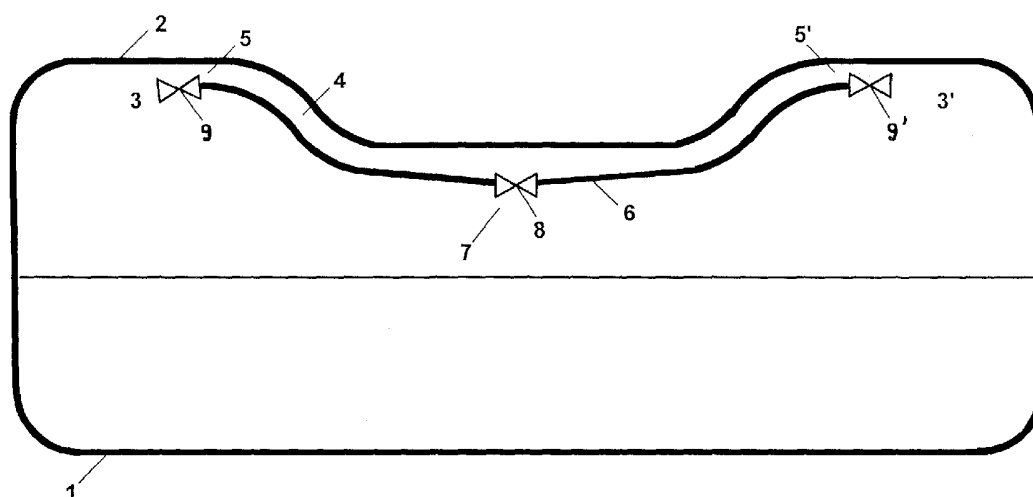
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

[Continued on next page]

(54) Title: FUEL TANK WITH INTERNAL VENT LINE



(57) Abstract: Fuel tank (1) comprising an upper wall (2) which comprises at least two regions (3,3') liable to contain independent pockets of gas when the liquid reaches a high level in the tank and/or when the tank is inclined, said fuel tank (1) being equipped with a venting system comprising: at least one internal vent line (4) connecting ventilation points (5,5') located in the upper part of the regions (3,3'); float valves (9,9') located at each ventilation point (5,5'); and at least one siphon-shaped lower part (6) in the vent line; characterized in that said lower part (6) contains a draining means (7) which acts as a capacity intended to collect and hold any liquid and which comprises a non-return valve (8) adapted to be opened by a predetermined weight of liquid.



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

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Fuel tank with internal vent line

The present invention relates to a venting system for a fuel tank of a motor vehicle.

Motor vehicle fuel tanks are generally fitted with a venting system which guarantees safety with respect to the environment when the tank is subjected to various influences: movements in all directions and of any amplitude, thermal stress, depression and overpressure. This venting system allows the air and gases present in the tank, above the liquid, to be removed and thus, prevents pressurization of the tank; It also prevents the creation of a vacuum therein as a result of variations in liquid volume that are due to fluctuations in temperature or in atmospheric pressure or to the drop in level as the liquid is drawn off.

Such systems generally implement safety valves immersed in the tank and the upper part of which passes through a wall thereof. These valves generally open onto a duct leading to a vapor canister containing a material capable of trapping liquid vapors present in the gases coming from the tank, before letting the air they contain out to the atmosphere. In this regard it can be referred to e.g. GB-A 2 269 375 and US 6,532,983, which respectively describe a duckbill shaped valve at the bottom of a drainable capacity, and an inverted umbrella shaped valve in series with a drainable capacity, the latter preventing, in particular circumstances of use, such as abrupt movements or excessive inclination of the vehicle containing the tank, liquid from the tank to get past the safety valve barrier and find itself in the duct leading to the canister, or may even reach this canister and disrupt the free passage of vapors.

Furthermore, for reasons of space constraint and, in particular, of the internal design of the vehicle, the tank may have a complex shape. It often includes, in its upper wall, indentations or regions liable to contain independent pockets of gas when the liquid reaches a high level in the tank and/or when the vehicle is on an incline. Each of these regions must therefore include at least one ventilation point in order for it to be vented. The various ventilation points may be connected directly to the external environment (parallel connection) or, more simply, they may be connected together with a single vent. In the latter case, the connection is performed by a ventilation line, which, for environmental reasons, is advantageously an internal vent line (i.e. located inside the fuel tank). In that

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case, and with complex fuel tank geometries, this line may include one or more lower parts in the form of a siphon. As a result, sumps in the ventilation line are created due to the complex geometry.

5 These sumps leave the ability for the ventilation line to collect liquid fuel, which is likely to reach and contaminate the canister in some circumstances (inclination for instance). Obstruction of the ventilation line by liquid blocks may also interfere with common engine off leak tests. The weight of a column of fluid in the ventilation line could indeed be enough to create a false pressure difference resulting in a false passing of the leak detection test.

10 A known solution for preventing the formation of liquid blocks in vent lines consists in providing each ventilation point with a float valve as those described above. However, this solution does not make it possible to prevent condensed gases from accumulating in certain parts of the ventilation lines, especially in the siphons, and from obstructing the ventilation lines.

15 Accordingly, US 6,089,249 discloses a venting system for a liquid tank, the upper wall of which comprises at least two regions liable to contain pockets of gas, said system consisting of at least one ventilation tubing connecting ventilation points located in the upper part of the regions and a vent, and having at least one siphon-shaped lower part connected via a pipe to a point under
20 vacuum inside the tank so as to allow the liquid present in the venting system to be removed, the vacuum being created by a pump. The venting system according to US 6,089,249 is faced with the problem that a vacuum pump is required to permanently keep a part of the tank under vacuum. Such a draining device is rather laborious and costly.

25 It is therefore an object of the present invention to provide a cost effective alternative to the one of prior art described above.

It has been found that this technical problem can be solved by the subject matter of the claims, i.e. by a fuel tank comprising an upper wall which comprises at least two regions liable to contain independent pockets of gas when
30 the liquid reaches a high level in the tank and/or when the tank is inclined, said fuel tank being equipped with a venting system comprising:

- at least one internal vent line connecting ventilation points located in the upper part of the regions;
- float valves located at each ventilation point ; and
- 35 - at least one siphon-shaped lower part in the vent line

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wherein said lower part contains a draining means which acts as a capacity intended to collect and hold any liquid and which comprises a non-return valve adapted to be opened by a predetermined weight of liquid.

5 The venting system according to the invention is safe and simple in construction. The obstruction of the ventilation lines by liquid blocks can be efficiently reduced and the fuel tank according to the invention is thus compatible with different types of engine off leak detection. Indeed, it is only when the fuel level in the tank remains high (above the lower point of the sump) for a long time during which evaporation/condensation can occur while the
10 draining means cannot function, that there could be formation of a liquid block. But this is a marginal situation and the amount of liquid concerned is limited anyway.

As explained above, the key point of the invention is the use of a draining means instead of a vacuum pump, said draining means comprising a non-return
15 valve adapted (calibrated) to be opened under the action of a given weight (amount) of liquid. Embodiments of such non-return valves are described in the aforementioned documents GB-A 2 269 375 and US 6,532,983, the content of which in that regard being enclosed to the present invention.

Accordingly, in a first embodiment, the non return valve may comprise a
20 flexible diaphragm closing an orifice situated at a low point of the capacity, as described in the US patent. More preferably, as described in that document, this diaphragm is in the form of an inverted umbrella. It is preferably made of an elastomer (i.e. a natural or synthetic rubber).

In a second embodiment, as described in the GB patent, it is a duckbill-
25 shaped valve (like 12 in figure 2) or a ball valve (like the one of figure 3). Duckbill-shaped valves are preferred.

In order to prevent liquid entrance through the ventilation points of the tank according to the invention, these are (as known from prior art and namely from afore mentioned US 6,089,249) equipped with float valves.

30 Preferably, in order to avoid entrainment of liquid droplets in the vent line despite these valves, the ventilation points advantageously comprise a draining capacity as well. These are preferably of the same type as described above. They can either be directly integrated in said valve (i.e. both being of one piece, sharing the same housing) or in line with the float valves (i.e. in series with the
35 float valve, further inside the vent line). The latter solution allows the choice of different valve suppliers for each part.

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More preferably, these float valves include a ROV function (i.e. the function of a Roll-Over Valve) as well. As described in US 6,532,983, this ROV function can be achieved simply and efficiently by means of a cage with a perforated well situated under the float valve, in which well there rests a dense ball which, when it moves under the effect of gravity, pushes the float of the float valve upwards and closes a needle-type valve, a moving part of which is secured to this float and capable of blocking off a valve outlet duct. As described in said US patent as well, in order to limit the impact of waves, the cage of the float valves can advantageously be extended below the well by a skirt. Alternatively, when the valve has no ROV function, it is the housing of the float valve itself that can be extended by a skirt below the minimal float level (generally set by support means).

Figures 1 to 5 further illustrate the subject matter of the invention but are not to be construed as limiting its scope.

Figure 1 shows a fuel tank (1) according to the invention comprising an upper wall (2) which contains regions (3) and (3') liable to contain pockets of gas. This tank is equipped with a venting system comprising an internal vent line (4) connecting ventilation points (5) and (5') located in the upper part of the regions (3) and (3'), respectively. A lower part (6) of the vent line (4) is siphon-shaped and contains a draining means (7).

This draining means (7) acts as a capacity for collecting liquids and it contains a non-return valve (8) which is adapted to be opened by exerting a predetermined gravitational force. In other words: it is calibrated to open under a given load of liquid. This valve (8) prevents liquid from entering the vent line (4) while allow liquid that would be trapped therein to be drained off when the fuel level is below that part (6).

Each ventilation point (5,5') is equipped with a float valve (9,9') which acts to prevent liquid from entering the vent line (4) in the case the tank is inclined and/or the fuel level is too high.

Figure 2 shows a first embodiment of the non return valve (8) of the tank of figure 1, which is a duckbill-shape valve.

Figure 3 shows a second embodiment for valve (8), which is a reverted umbrella style valve.

Figure 4 shows a first embodiment of float valve (9,9') according to the invention and consisting of a float (1) contained in a cage (2). When the valve is submerged in liquid, the float rises and a seal (4) prevents fluid communication

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between the valve inlet (3) and the vapor space above the seal (5) that is in direct fluid communication with the internal vapor line. Integrated into this valve is a "duckbill" style valve (6) to prohibit any liquid that passes through the float valve entrance (3) to be entrained in the vent line.

- 5 Figure 5 shows another embodiment similar to the one of figure 4, except that it uses a commonly known "umbrella" style valve instead of a "duckbill" style valve to prohibit any liquid from passing into the internal vent line.

CLAIMS

1. - Fuel tank (1) comprising an upper wall (2) which comprises at least two regions (3,3') liable to contain independent pockets of gas when the liquid reaches a high level in the tank and/or when the tank is inclined, said fuel tank
5 (1) being equipped with a venting system comprising :
- at least one internal vent line (4) connecting ventilation points (5,5') located in the upper part of the regions (3,3');
 - float valves (9,9') located at each ventilation point (5,5'); and
 - at least one siphon-shaped lower part (6) in the vent line;
- 10 characterized in that said lower part (6) contains a draining means (7) which acts as a capacity intended to collect and hold any liquid and which comprises a non-return valve (8) adapted to be opened by a predetermined weight of liquid.
2. - Fuel tank according to the preceding claim, characterized in that the non-return valve (8) comprises a flexible diaphragm closing an orifice situated at
15 a low point of the capacity.
3. - Fuel tank according to the preceding claim, characterized in that the diaphragm is made of an elastomer in the form of an inverted umbrella.
4. - Fuel tank according to claim 1, characterized in that the non-return valve (8) is duckbill-shaped.
- 20 5. - Fuel tank according to any of the preceding claims, characterized in that the ventilation points (5,5') are provided with draining means as well.
6. - Fuel tank according to the preceding claim, characterized in that the draining means of the ventilation points (5,5') are in line with the float valves (9,9').
- 25 7. - Fuel tank according to the preceding claim, characterized in that the draining means of the ventilation points (5,5') are integrated to the float valves (9,9').

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8. - Fuel tank according to any of the preceding claims, characterized in that the float valves (9,9') include a ROV function.

5 9. - Fuel tank according to the preceding claim, characterized in that the ROV function of the float valves (9,9') is achieved by means of a cage with a perforated well situated under the float valve, in which well there rests a dense ball which, when it moves under the effect of gravity, pushes the float of the float valve upwards and closes a needle-type valve, a moving part of which is secured to this float and capable of blocking off a valve outlet duct.

10 10. - Fuel tank according to the preceding claim, characterized in that the cage of the float valves (9,9') is extended below the well by a skirt.

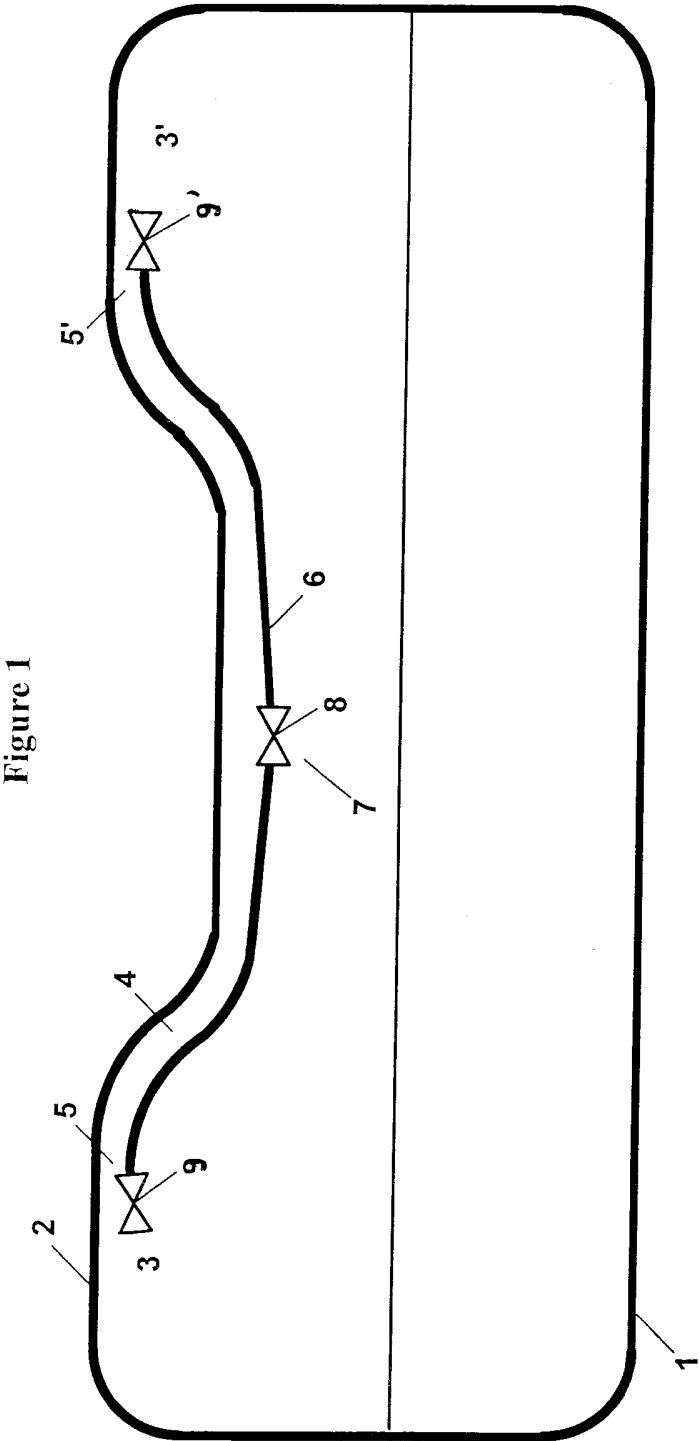


Figure 4

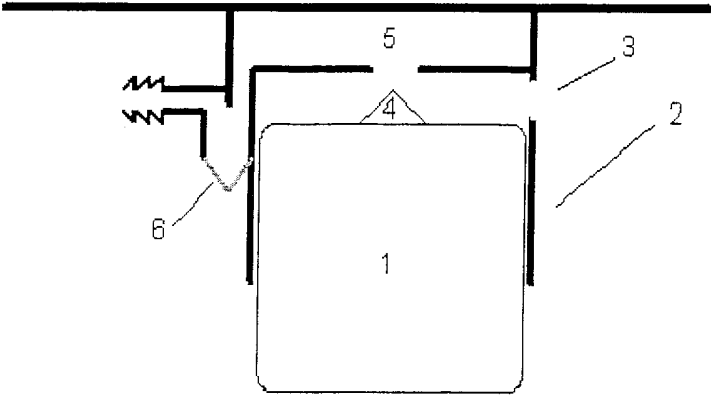


Figure 5

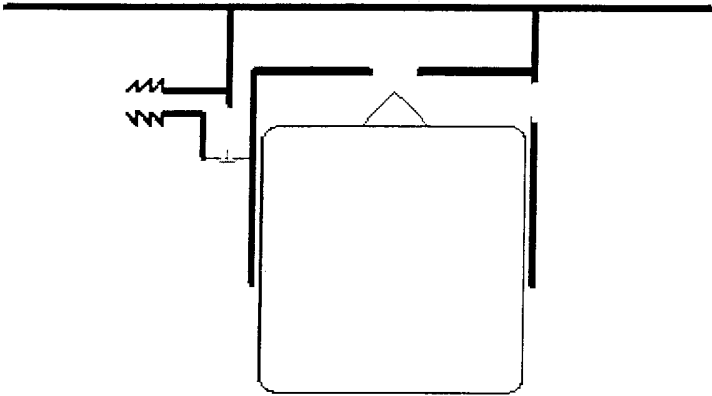


Figure 2

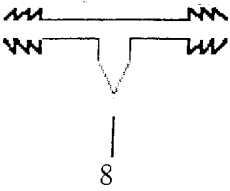
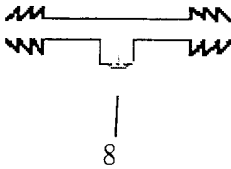


Figure 3



INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP2005/055010

A. CLASSIFICATION OF SUBJECT MATTER
B60K15/035

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B60K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

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☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

13 December 2005

Date of mailing of the international search report

20/12/2005

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2005/055010

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